123. U S WEST stated that to determine the capital structure for the BCPM the company weighted the marginal costs of debt and equity using the company's market value capital structure rather than using a capital structure based on the company's regulatory book value capital structure. The cost of new debt was calculated by taking an average mix of long term and intermediate term debt from U S WEST Capital Market Group estimates, published in its *Capital Markets Outlook.* The cost of capital was determined by taking the mid-point of the range of Discounted Cash Flow (DCF) and Capital Asset Pricing Models (CAMP) to U S WEST's trade stock, a group of telephone companies, and a group of comparable risk companies. The cost of equity estimates were checked for reasonableness against an estimate of investors' expected return on the stock market as a whole and against an equity risk premium estimate for U S WEST.

124. AT&T provided no analysis on the cost of capital in the testimony from Brian Pitkin. The FCC has established criteria that must be met by a cost proxy model. The FCC requires that the cost of capital should be either the authorized federal rate of return on interstate service, currently 11.25 percent, or the state-prescribed rate of return for intrastate service.

125. Currently U S WEST regulatory capital structure and costs are as follows:

	Percentage	Cost	Rate of Return
Long-term Debt	50.00 %[28]	8.88 %[29]	4.44 %
Common Equity	50.00 %	12.00 %[30]	6.00 %
Total	100.00 %		10.44 %

[28]Capital structure approved in Docket No. 86.11.62, Order 5279a.

[29]Cost of debt approved in Docket No. 86.11.62, Order 5279a.

[30]Cost of common equity approved in Docket No. 88.12.55, Order 5398a.

126. In Docket No. 96.11.200, Order 5961b, the Hatfield default values were used, to provide consistency with the previous order. The Commission adopts the Hatfield default values to be used for the cost of capital in this Docket.

B. Structural Sharing Percentages

127. Structural sharing refers to the ability of a telephone company to share placement costs of its cable facilities with other utility companies. Structural sharing can occur when a telephone company places aerial cable, buried cable (trenching) and underground cable (conduit).

128. U S WEST's witness Mark Schmidt stated that the BCPM assumes that sharing of cable facilities will occur at the following percentages: aerial cable 50 percent, buried cable 20 percent, and underground cable 20 percent.

129. AT&T witness Dean Fassett did not provide the specific sharing default inputs included in the HAI. Mr. Fassett indicated that for aerial cable the model assumes that 25 percent or less of the costs of a pole are assigned to the telecommunications provider. For buried and underground cable, he provides only a general discussion of the possible sharing of cable facilities and no default inputs.

130. Generally the Commission adopts sharing percentages that represent a compromise between the two parties' positions. In Docket No. 96.11.200, Order 5961b provided a 33 percent sharing for aerial installation for feeder and distribution facilities. It also provided a 66 percent sharing assumption for both buried and underground feeder and distribution facilities. Due to the structure of both models, sharing assumptions are broken down into multiple density zones. The Commission concludes that it is reasonable to calculate the sharing percentages for

feeder and distribution by taking the average of the BCPM and the HAI default inputs for each density zone.

131. For the remaining user-defined inputs the Commission adopts BCPM default inputs to determine the cost.

V. CONCLUSIONS OF LAW

1. The Commission has authority to supervise, regulate and control public utilities. Section 69-3-102, MCA. U S WEST is a non-rural public utility offering regulated telecommunications services in the State of Montana. Section 69-3-101, MCA.

2. The Commission has authority to do all things necessary and convenient in the exercise of the powers granted to it by the Montana Legislature and to regulate the mode and manner of all investigations and hearings of public utilities and other parties before it. Section 69-3-103, MCA.

3. The United States Congress enacted the Telecommunications Act of 1996 to encourage competition in the telecommunications industry. Congress gave responsibility for much of the implementation of the 1996 Act to the states, to be handled by the state agency with regulatory control over telecommunications carriers. *See generally*, Telecommunications Act of 1996, Pub. L. No. 104-104, 110 Stat. 56 (*amending scattered sections of the* Communications Act of 1934, 47 U.S.C. §§ 151, *et seq.*). The Montana Public Service Commission is the state agency in Montana charged with regulating telecommunications carriers in Montana and properly exercises jurisdiction in this Docket pursuant to Title 69, Chapter 3, MCA.

4. Adequate public notice and an opportunity to be heard has been provided to all interested parties in this Docket, as required by the Montana Administrative Procedure Act, Title 2, Chapter 4, MCA.

5. The Commission has the authority to adopt a cost model for Montana for federal universal service funding. Where the Commission has regulatory jurisdiction, it must apply federal law as well as state law, and where Congress has preempted state law, the Federal law prevails. *See* FERC v. Mississippi, 102 S.Ct. 2126 (1982).

6. Congress gave the FCC authority to implement § 254 of the 1996 Act. The FCC has permitted states to choose a cost model for their respective state, but the FCC has the ultimate authority whether to accept a cost model presented by a state commission. The Montana Commission properly submits this Order to the FCC for purposes of federal universal service support, with the following three attachments as required by the FCC's Public Notice in CC Docket Nos. 96-45 and 97-160, DA98-217 (Feb. 27, 1998): (1) Attachment a (the text document), (2) Attachment b (inputs for Montana), and (3) Attachment c (outputs for Montana).

VI. ORDER

THEREFORE, based upon the foregoing, it is ORDERED that the BCPM Model 3.1 will be used for determining federal universal service support for Montana, subject to the approval of the FCC.

DONE AND DATED this 21st day of May, 1997, by a vote of 5-0.

BY ORDER OF THE MONTANA PUBLIC SERVICE COMMISSION

Dave Fisher

DAVE FISHER, Chairman

Nancy McCaffree

NANCY MCCAFFREE, Vice Chair

Bob Anderson

BOB ANDERSON, Commissioner

Danny Oberg

DANNY OBERG, Commissioner

Bob Rowe

BOB ROWE, Commissioner

ATTEST:

Kathlene M Anderson

Kathlene M. Anderson
Commission Secretary

(SEAL)

NOTE: Any interested party may request the Commission to reconsider this decision. A motion to reconsider must be filed within ten (10) days. See ARM 38.2.4806.

VII. ATTACHMENTS

Attachment a

Text Document

Text Document

A. General and Supporting Information

1. State:

Montana

2. Date of Filing:

May 26, 1998

3. Contact Person & Telephone Number (also include electronic mail address):

Dennis Crawford
Montana Public Service Commission
PO Box 202601
Helena, MT 59620-2601
(406) 444-6182
Dcrawford@mt.gov

4. Hardware Requirements (i.e., disk space, memory requirements, etc.):

1 Gigabyte of Hard Drive Space

5. Software Requirements (i.e., operating system and version, spreadsheet software and version. etc.):

Computer must meet the following requirements :

Windows '95
Pentium Processor 120 MHZ (200 MHZ - Recommended)
16 MB RAM (32 MB Recommended)
Microsoft Excel '97 with VB Data Access Objects

6. General Description of Study (identify whether study is based on the Benchmark Cost Proxy Model (BCPM) or HAI Model (identify version), a study or model prepared by a local exchange carrier (LEC), a state study or model for pricing unbundled network elements or other source):

BCPM 3.1 is a computer model designed to estimate forward economic costs to provide business and residential basic local telephone services as required by the FCC. It is based in Microsoft Excel with a user interface developed in Visual Basic for Applications.[1]

7. Supporting Information

(a) Please provide supporting information that includes a detailed description of the proposed cost study and all underlying data, formula, computations, and software associated with the study. The documentation should include a complete listing of algorithms and formulas used in the study and in any pre-processing modules. The supporting information should begin with an overview of the basic approach taken in the cost study, including the study's general methodology and basic assumptions. (Note: If the state cost study is a version of a cost model that is already being considered by the Commission as the basis for determining federal high cost support, it is not necessary to provide all underlying documentation; if the proposal contains changes to the algorithms or inputs of a model under consideration by the Commission, however, such changes must be clearly documented.)

BCPM 3.1 is comprised of a series of modules in functional areas pertinent to the design and costing of a forward looking telecommunications network. These modules include:

1. <u>Preprocessor Module:</u> This module formats some of the raw input data for further processing, identifies the locations of customers within the wire center, and builds the grid system and feeder plant routes used to design the distribution cable system.

2. <u>Outside Plant Module:</u> This module designs and costs the distribution cable system.

3. <u>Switch Module:</u> This module designs and costs the digital network of host/remote/stand alone switches based on the locations of the actual in-place network.

4. <u>Transport Module:</u> This module designs and costs the SONET interoffice transport system.

5. <u>Capital Cost Module:</u> This module develops depreciation, rate of return, and tax factors and applies them to the investment accounts to produce the capital cost.

[1]Please note: All answers contained in this document come directly from submitted testimony.

6. Operating Expense Module: This module determines the annual expense cost attributable to providing universal service.

7. Report Module: This module summarizes the results of the previous modules.

Customer Location Methodology

BCPM 3.1's customer location algorithm uses Census data at the CB level and wire center boundaries provided by Business Location Research to determine the location of customers. Additionally, BCPM 3.1's customer location algorithm overlays wire centers with grids which focus on road miles where people are more likely to be located. Furthermore, BCPM 3.1 uses a dynamic grid which varies in size to ensure that the number of customers included in a grid takes into account Carrier Serving Area (CSA) engineering guidelines.

In general, a series of reaggregation steps subsequently combines grids into various sizes, consistent with an efficient network design. Each grid's size, cost characteristics, and number of lines are integrally linked to telephone engineering CSAs and DAs. There are a number of steps involved in this process:

1. Specify the appropriate wire center boundaries;
2. Use the CB level of data that falls within the corresponding wire center boundary; and
3. Create the variable size grids from the CB data within the wire center boundaries.

It is also necessary to establish microgrids to appropriately aggregate populated areas into telephone engineering CSAs and DAs. The first phase entails assigning CB data to microgrids. The second phase of the grid process entails aggregating these microgrids into larger grids as appropriate. The ultimate grid size utilized essentially reflects the manner in which customers are clustered.

The derivation of grids is essentially an iterative process where partitioning occurs if the number of lines within a grid is too large, or if other technological constraints become binding. The macrogrid is partitioned into smaller grids, if warranted, based on household and business line data associated with the underlying microgrids, and CSA guidelines. The iterative process partitions the macrogrid into four equally sized subgrids. Additional sub-partitioning and re-combining continues to occur until all grids satisfy line size and technological constraints. The smallest grid allowed is the 1/200th of a degree latitude and longitude, the microgrid. The resulting ultimate grids have a composite household and business line count equal to the sum of the household and business lines for the associated underlying microgrids.

Outside Plant Methodology

The loop module is designed to develop the loop costs associated with providing basic telephone service. The following information supports the model:

1. Engineering protocols are used to design this model and they include an average maximum loop length for each CSA that is less than 12,000 feet. To ensure attainment of this standard, the maximum ultimate grid size is typically constrained to 1/25th of a degree latitude and longitude (approximately 12,000 feet by 14,000 feet). The design of the ultimate grids ensures that the maximum copper loop length from the DLC site to the customer for any individual customer should not exceed 18,000 feet.

2. Beginning at the wire center, there are a maximum of four main feeder routes that run directly east, north, west and south from the wire center to serve four feeder quadrants. These routes run for 10,000 feet. This is based on the assumption that within 10,000 feet, customers are generally located within the perimeter of a town and that the town has some sort of gridded street complex. Beyond 10,000 feet, the direction of each main feeder is determined by customer concentrations as reflected in the microgrid information data.

3. If the line count in the center 1/3 of a feeder quadrant is greater than 30% of the total feeder quadrant lines, this feeder potentially remains a single feeder and potentially points to the population centroid of the entire feeder quadrant. If the line count in the center 1/3 of a feeder quadrant is less than 30% of the total feeder quadrant lines, the feeder splits into two main feeders each potentially pointed at the population centroid in one half of the feeder quadrant. Each portion of the split main feeder is sized according to the number of customers that it serves. This breakpoint should capture the need to split the cable to avoid any natural barriers. Any time the model logic indicates that the main feeder should be redirected, or split, at the point 10,000 feet from the central office, a test is run to determine if feeder length is minimized by continuing in the cardinal direction, (north, south, east and west).

4. From the main feeder, subfeeders branch out toward the individual ultimate grids. Subfeeder is potentially shared by more than one ultimate grid. Along a main feeder within 10,000 feet of the wire center, subfeeders may branch off the main feeder every 1/200th of a degree

boundary. Along a main feeder beyond 10,000 feet of the wire center, subfeeder branches out at most, once between 1/25th of a degree boundary.

5. A DLC site is established (where loop lengths exceed the copper/fiber breakpoint) within each CSA at the road centroid of the ultimate grid. The number of DLCs placed at the DLC site depends on the number of lines served in that CSA. The model allows for two DLC categories, each providing multiple size options of remote and central office terminal size.

6. If a CSA is served by copper feeder, the cross connect where copper feeder facilities are connected with copper distribution facilities (the feeder/distribution interface (FDI) site is established at the road centroid of each populated distribution quadrant or shared by distribution quadrants, depending upon line demand.

7. The type of cable used in the feeder system is determined based on the specified copper/fiber breakpoint.

8. Each ultimate grid is divided into four potential DAs.

9. U.S.G.S and Soil Conservation Service data for four terrain characteristics that impact the structure and placement cost of telephone plant are included as inputs to BCPM 3.1 by CBG and assigned to an ultimate grid.

10. The model recognizes conduit and pole structure that is shared with power and cable industries.

Switching

The BCPM-Switching Module (BCPM-SM) is designed to develop per line switching costs for Universal Service Fund (USF) applications and to provide the basis for UNE costs. The model:

1. Uses separate cost equations for host, stand alone, and remote switches;
2. Provides global data inputs for those study areas where specific data are not available;
3. Can accept switch investments from several sources;
4. Analyzes input data files to determine whether switch capacity constraints have been exceeded for any wire center, and if so, places an additional switch in that wire center; and
5. Determines the realistic portion of each switch attributable to basic telephone service, by means of engineering based partitioning algorithms derived from the ALSMs.

The process for determining per line switching costs for universal service can be summarized in four major phases:

1. The model compiles the switch-specific data inputs to be used for investment development.

2. BCPM generates total switch investments by functional category (FCAT) for each switch.

3. The model uses these FCAT investments to generate a Busy Hour unit investment for each basic switch function, based on the subscriber calling usage rates input into the model.

4. The model computes the universal service investment per line from the Busy Hour functional unit investments.

<u>Transport</u>

In the Transport Cost Proxy Model (TCPM) module, BCPM 3.1 uses information on existing interoffice traffic routing relationships between remote/host/tandem switches to develop forward looking transport costs using SONET technology. TCPM deploys sophisticated optimization algorithms to determine the most efficient ring configuration for a given study area. These algorithms utilize actual data on remote/host/tandem switch homing relationships, V&H coordinates, number of working lines, and access line to trunk ratios (used to derive traffic characteristics). The TCPM module is a flexible Excel spreadsheet model, permitting cost analysis for an area as small as a single exchange or as large as an entire company. The user also has the ability to alter all of the primary transport cost inputs. The module:

1. Utilizes efficient SONET bandwidth given the specified host and remote locations, number of access lines, and trunks;

2. Uses only SONET technology that is currently available in the market;

3. Provides one level of redundancy via what is commonly referred to as self-healing rings;

4. Provides a second level of redundancy by using two sets of lines for offices served by a folded ring;

5. Includes a third level of redundancy by providing one extra DS1 for every seven working DS1s on the port side in a central office;

6. Determines the number of rings to be built and the sequences of nodes

on the ring;

7. Allows the user to run the model for a single ring, thereby enabling the user to trace the cost calculations through the logic of the model;

8. Maps the nodes subtending a particular host or tandem; and

9. Provides the following reports for each ring: a) transport cost results for all of the rings; b) transport configuration of all of the rings; and c) universal service transport cost on a per line basis.

The assumptions made by the model are:

1. All remote offices are connected to their respective host offices via SONET rings (if there is only one remote a folded ring is assumed). All host offices are connected to their respective tandems via SONET rings.

2. Unidirectional SONET deployment is assumed. (Transport Cost Proxy Model, p. 2, Attachment to 8/8/97 Joint Comments of Bellsouth Corporation, Bellsouth Telecommunications, Inc., U S WEST, Inc., and Sprint Local Telephone Companies to Further Notice of Proposed Rulemaking Sections III.C.3.a-d, III.C.4)

Signaling

Signaling costs for use in developing per line investments for BCPM 3.1 are provided through a user input table which reflects the cost of building a modern SS7 network. The input table provides investments for Residence and Business lines for small, medium and large companies. The signaling cost for a wire center is based on a weighted average of residence and business lines associated with that wire center. Values in the input table are developed by running the BCPM Signaling Cost Proxy Module (SCPM) for portions of the U S WEST territory. Users have the option to either use the provided default values or input their own values.

Support Plant

Once the model calculates the loop, switching and interoffice plant (excluding land and building) needed for each Grid, user adjustable investment ratios are used to load in the support investments. Support investment represents those plant items not directly used in the provisioning of basic service.

BCPM 3.1 produces estimates of total investment less support investment in the loop module. Support investment estimates are derived through the application of support factors, whose values are directly specified by the user. These factors represent the ration of support investment in various accounts to total investment, less support, land and building investment.

Capital Costs

The BCPM 3.1 Capital Cost Module develops a series of annual charge factors for depreciation, rate of return and tax rates that when applied to individual investment categories developed in other modules, produce capital costs for use in developing Universal Service Fund costs. The module incorporates all of the methodologies that are currently in practice today, including: Deferred taxes, Mid-year, Beginning Year, and End Year placing conventions, Gompertz-Makeham Survival curves, Future Net Salvage Values, Equal Life Group methods and many others. The module also incorporates separate Cost of Debt and Equity rates, along with the Debt to Equity ratio.

Operating Expenses

The estimation of operating expense in BCPM 3.1 is the result of an application of user-adjustable expense factors. BCPM 3.1 allows the user to specify operating expenses as either a per access line amount or as a percent of investment.

Report Module

The Report Module provides the final step in the process of developing universal service support levels. In the module, costs factors, including depreciation, return and taxes, are combined with operating expenses to generate monthly costs. Monthly costs are then used to calculate universal service support for a given benchmark. These support levels are available at the grid, wire center, company, Census Block Group (CBG) or state level.

(b) Please identify the sources of all underlying data used in the study and state whether these sources are included with this filing. If not, explain why not.

The user has the option of either running BCPM 3.1 with user adjustable inputs, the default inputs or the Montana specific inputs for U S WEST.

With regard to the Montana specific inputs, the material cost inputs and the structure cost inputs are like the U S WEST Montana specific data used in the U S WEST TELRIC models. Thus, these material prices reflect prices U S WEST pays for this equipment and services.

These inputs include material costs for equipment such as copper and fiber cables, feeder-distribution interfaces, switching equipment, digital loop carrier equipment and other circuit equipment. Additionally, the cost of telephone plant structures, such as digging trenches for buried and underground cable is also Montana specific. Further, Montana census data, geologic data, wire center line counts for residential and business customers, as well as the appropriate state tax rates are included. Lastly, the operational expense data input to the model reflect the forward-looking operational expenses of providing basic local service in Montana. BCPM output includes costs utilizing the Montana PSC's prescribed cost of money and depreciation lives, as well as costs developed using forward-looking cost of money and depreciation.

With regard to the BCPM 3.1 default inputs, BellSouth, Sprint and U S WEST, Joint Sponsors of BCPM 3.1, provided an industry-wide composite of current material, installation and structure prices for individual network components used in BCPM 3.1. This includes the prices for cables, digital loop carrier equipment, switches, feeder/distribution interfaces, manholes, poles and other components. These figures allow BCPM 3.1 to use the widest possible base of data for equipment and installation prices currently paid by local exchange carriers. Additionally, the Joint Sponsors provided an industry-wide composite of forward-looking operational and overhead expenses by account that are specifically associated with the provision of local exchange service. Finally, the Joint Sponsors developed industry-wide, forward-looking cost of capital and depreciation lives by account. In addition to the default inputs, the user has the option with most of the inputs to either develop inputs or use a combination of user inputs and model defaults.

B. Demonstration That the Cost Study Fulfills the Order's Criteria for State Cost Studies

Criterion 1: ***The technology assumed in the cost study must be the least-cost, most-efficient, and reasonable technology for providing the supported services that is currently being deployed. A model, however, must include the incumbent LECs' wire centers as the center of the loop network and the outside plant should terminate at incumbent LECs' current wire centers. The loop design incorporated into a forward-looking economic cost study or model should not impede the provision of advanced services. For example, load coils should not be used because they impede the provision of advanced services. Wire center line counts should equal actual incumbent LEC wire center line counts, and the study's or model's average loop length should reflect the incumbent carrier's actual average loop length.***

(a) Describe the network technology for which costs are computed,

including switch type used, feeder and distribution technology, digital loop carrier devices, and other electronics if any; type of interoffice technology; and any assumptions, such as maximum copper loop lengths or copper resistance constraints.

Switching

For Large wire centers, BCPM uses a switch curve based on Lucent 5ESS and Nortel DMS-100 digital switches. The model has separate switch curves for host, remote, and stand alone switches for both vendors, to support current and forward-looking deployment practices. For small wire centers, BCPM uses a default switch curve that includes Nortel, Siemens Stromberg-Carlson, Lucent, and Mitel switches[2].

Feeder Equipment

The Model allows for two DLC categories, each providing multiple size options of remote and central office terminal size. This permits placement of small DLCs in CSAs that serve a relatively small number of customers. Both large and small DLCs are assumed to be integrated DLC systems. In addition, U S WEST asserts the Model captures efficiencies garnered from large DLCs where appropriate. The decision to use either a small DLC or a large DLC is based on the number of lines the DLC can serve. Given an engineering fill factor of 90%, a small DLC is placed if the CSA serves less than 216 lines, i.e. 240 times 90%. This engineering fill factor is a user adjustable input.

A typical DLC remote cabinet size for a large DLC, such as the "Litespan-2000", can serve only up to 1,344 lines. Whether more DLCs are placed in that CSA depends on whether sound engineering practices call for another DLC or whether it is optimal to divide a grid further, into smaller ultimate grids, each representing a CSA. For example, it is possible for a single CSA to serve 5,000 customers if a large number of customers are located in a single office complex In this case, multiple DLC systems would be installed to provision the 5,000 lines.

The large DLC Remote Terminal (RT) used in BCPM is the DSC Litespan LSC-2030 Remote Terminal Outdoor Cabinet which supports up to 1344 lines. BCPM assumes that the Litespan RPOTS channel unit is used in the RT except in cases where distribution cable lengths exceed CSA standards. In these cases, a RUVG2 or REUVG channel unit is recommended per DSC Litespan

[2] David Gabel, "Estimating the Cost of Switching and Cables based on Publicly Available Data--Status Report", draft report presented to the FCC, August 20, 1997.

Practice OSP 363-20-010 Issue 6, July 1997 at 5.3.2. The BCPM sponsor's transmission engineers use the REUVG card in actual networks. The REUVG is used on extended range loops in BCPM3.1 because for the modest increase in cost, it provides superior performance and significantly greater flexibility in application.

Feeder Cable

The type of cable used in the feeder system is determined based on the specified copper/fiber breakpoint. The copper/fiber breakpoint is a user adjustable input.[3] The default input for the copper/fiber breakpoint is 12,000 feet. A copper/fiber breakpoint of 12,000 feet requires placing copper in the feeder if the maximum loop length from the wire center to all customers within an ultimate grid is less than 12,000 feet. If the loop length for any customer in the ultimate grid exceeds 12,000 feet, fiber is placed in the feeder to serve all customers in the ultimate grid. For all loops, cable beyond the DLC site is copper.

Feeder cables are sized to accommodate the number of working lines based on total residential, business, and special access lines. The size of feeder cables is based on the number of actual working lines adjusted by a variable engineering fill factor. For example, at an 85% engineering fill factor, a 400 pair cable can accommodate 340 working pairs before increasing the cable size. The default assumes a 75% engineering fill factor for the lowest density zone, an 80% engineering fill factor for the next two lowest density zones, and an 85% engineering fill factor for the remaining six density zones. These engineering fill factors for feeder cable are user adjustable inputs.

The total capacity for a fiber feeder segment is the sum of the required large DLC fiber strands and required small DLC fiber strands. BCPM 3.1 determines the number of maximum size fiber cables and the size of the additional fiber cable to meet the capacity needs of the segment. The fiber feeder cable sizes available in the Model are 12, 18, 24, 36, 48, 60, 72, 96, 144, and 288 strands.

In selecting fiber vs. copper technology, BCPM recognizes the impact of duct congestion in urban areas. Copper technology in dense areas can quickly result in large numbers of full size cables in the duct runs along the main feeders or initial subfeeder segments. Costs are increased for deeper or wider trenching and larger manholes. BCPM uses fiber and electronics where grids must be served with more pair than in a single maximum sized cable.

---

[3] The Model allows the user to set the copper/fiber break point between 6,000 feet and 18,000 feet, given 3,000 foot increments.

BCPM allows the user to adjust economic crossover based on user specific studies or constraints. Examples of current jurisdictional constraints that BCPM can incorporate are:

- All plant must be out-of-sight;
- All plant must be buried;
- Stream or river crossings must be placed in conduit;
- Restricted street openings or highway crossings;
- Special road clearance requirements; and
- Buried or underground highway "dips".

The feeder cable is connected to distribution cable at a feeder/distribution interface, commonly called an FDI. The FDI connects many distribution cables to a feeder cable.

Distribution Equipment

The BCPM distribution technology is designed to support a transmission rate of 64Kbps on all loops. All customers within 12,000 feet of the central office are served with 26 gauge copper facilities. Customers beyond this distance are served from a Digital Loop Carrier (DLC) system connected to the central office by fiber facilities.

In determining the number of FDIs to install in an ultimate grid, the Model reviews the cable sizing used in the Grid. When the distribution cable sizing exceeds 1,200 pairs, the Model places an FDI at the road centroid within each populated distribution quadrant. Thus, the FDI is placed at the center of the DA.

If there are no roads, and therefore, no population located within a particular distribution quadrant, no distribution plant is placed in that distribution quadrant. Feeder cable, consisting of horizontal and vertical connecting cable, links the DLC to the FDI within non-empty quadrants.

When the distribution cable sizing does not exceed 1,200 pairs, the Model allows for cost savings from placing fewer FDIs. More precisely, for ultimate grids that are served by distribution cables totaling less than 600 pairs, the algorithm essentially computes the cost of placing a single FDI within those ultimate grids. This is tantamount to co-locating the FDI with the DLC. In such cases, horizontal and vertical connecting cable[4] is placed from the ultimate grid road centroid to the road centroid of a non-empty quadrant's road reduced

---

[4] While this is typically considered distribution cable, the Model has fixed the classification of this cable as feeder. In a future release of BCPM, this cable will be classified differently.

cluster.

Within the Model there are a number of rules that are used to select specific pieces of equipment to be used in the distribution plant. Among those rules with the most impact are:

a. Within a grid, if the length of copper from the DLC to the last lot in a quadrant is less than 11,100 feet, 26 gauge cable is used to serve all customers. In those circumstances where the distance from the DLC to the last lot is greater than 11,100 feet, 24 gauge wire is used in all cables to and within the distribution quadrant. Where distances exceed 13,600 feet, extended range plug-ins are installed on lines that exceed 13,600 feet.
b. The mix of aerial, buried and underground facilities is determined by terrain and density specific to that grid.
c. Exterior Drop terminals are provided at each point where drops connect branch cables and are sized for the number of connecting drops.
d. Indoor building terminals are placed on each multi-tenant building and are sized for the number of lines terminated at that location.
e. Different NIDs are used for business and residence locations.
f. Branch cables are sized to the number of pairs for housing units and business locations.

Transport

The BCPM Transport module is based upon Synchronous optical network (SONET) technology. SONET is a set of standards for optical (fiber optic) transmission. It was developed to meet the need for transmission speeds above the T3 level (45 Mbps) and is generally considered the standard choice for transmission devices used with broadband networks. Technologies like T3 are likely to be replaced by new services offered through a SONET platform. By way of comparison, OC-1 can carry over 30 times more data than DS1.

SONET enables more efficient use of installed fiber; it taps the latent capacity already in the network. SONET allows new network configurations, including ring networks, which have a greater degree of survivability than traditional mesh networks. The transport module has three different size/bandwidth SONET terminals (OC3, OC12, OC48). The Model's algorithms select the appropriate terminal size/bandwidth based on traffic demands, making it an efficient model while building in redundancy to the network.

The BCPM 3.1 transport module uses manual digital cross connect systems as opposed to automated cross connect systems. Automated digital cross connects are typically associated with the provisioning of dedicated special services. In modeling basic service, BCPM 3.1 provides the cost of interoffice transport connections of umbilical switching trunks to a remote. For universal service purposes, the BCPM 3.1 sponsors advocate the use of manual cross connect technology as a more cost effective solution since these switched umbilical and interoffice trunks are not rearranged frequently. The use of automated digital cross connect technology at every node location would cause a cost increase in the interoffice transport element for Universal Service that is not warranted.

Equipment items included in the BCPM transport module include the following:

<u>Termination Equipment</u>

Fiber Tip Cable (Per Fiber)
Fiber Patch Panel (Per Fiber)
Sonet Terminal Shelf (OC3)
DS3 Card
DS1 Card (Per DS1)
Sonet Terminal Shelf (OC12)
OC3 Card
3 DS3 Card (OC12)
Sonet Terminal Shelf (OC48)
OC3 Card
3 DS3 Card (OC48)
DSX3 Cross Connect Shelf
DSX3 Cross Connect Card
DSX1 Cross Connect Jack Field
Channel Bank Shelf
Channel Bank Card

<u>Mileage Equipment</u>

Aerial Fiber (per fiber mile)
Underground Fiber (per fiber mile)
Buried Fiber (per fiber mile)

<u>Installation and Sheath</u>

Aerial Fiber (per fiber)
Underground Fiber (per fiber)
Buried Fiber (per fiber)

<u>Fiber Repeaters</u>

OC3

OC12
OC48

(b) Explain how this technology is the least-cost, most-efficient, and reasonable technology currently being deployed for providing the supported services that are reflected in your study. Are technology determinations based on engineering practice rules of thumb or explicit optimization processes? If relying on engineering practices, provide any studies that show that these practices result in a least-cost network. Describe any optimization routines or engineering rules of thumb that are used in the study to achieve a least-cost, most-efficient, and reasonable network design. In your response, please answer the following questions:

BCPM 3.1 "incorporates least-cost, most efficient and reasonable technology." In doing so, the BCPM 3.1 establishes an optimal grid size that is determined by adhering to sound engineering practices that reflect forward looking, least cost technology for providing basic service. In addition, internal algorithms "test" different scenarios to ensure the lowest cost alternative is assumed. (See Outside Plant Methodology, subpoint 3, question 7.a)

(1) Describe how the study determines whether feeder, sub-feeder, and distribution plant should consist of fiber or copper, and whether electronics, such a T-1 carrier system, are used in the feeder and subfeeder plant. Also, please describe the gauge(s) of copper considered in the study.

The type of cable used in the feeder system is determined based on the specified copper/fiber breakpoint. The copper/fiber breakpoint is a user adjustable input, however, the default input for the copper/fiber breakpoint is 12,000 feet. A copper/fiber breakpoint of 12,000 feet requires placing copper in the feeder if the maximum loop length from the wire center to all customers within an ultimate grid is less than 12,000 feet. If the loop length for any customer in the ultimate grid exceeds 12,000 feet, fiber is placed in the feeder to serve all customers in the ultimate grid. For all loops, cable beyond the DLC site is copper.

BCPM 3.1 does not use the obsolete T-1 carrier system in its feeder and sub-feeder. T-1 carrier on copper cable is unlikely to be an economical choice if all relevant costs are considered, because it requires specialized design and cable conditioning for each loop, an extremely expensive proposition.

Within a grid, if the length of copper from the DLC to the last lot in a quadrant is less than 11,100 feet, 26 gauge cable is used to serve all customers. In those circumstances where the distance from the DLC to the last lot is greater than 11,100 feet, 24 gauge wire is used in all cables to and within the distribution quadrant. Where distances exceed 13,600 feet, extended range plug-ins are installed on lines that exceed 13,600 feet. (Exhibit PBC-4, pp. 45-46 of Copeland Supplemental Direct)

(2) Describe how the model determines the feeder and subfeeder paths that connect distribution areas to the wire center. Does the model rely on current feeder paths or does the model choose a different path? If the study or model determines feeder paths, describe the algorithm that determines the feeder path. Similarly, a model will connect customer locations within a distribution area to the serving area interface. Does the model employ an optimization routine or employ a rule of thumb for determining distribution routes?

The BCPM 3.1 employs a multi-step process to design feeder. First, a maximum of four routes runs north, south, east and west for ten kilofeet from the central office. At this point a decision is made whether to angle or split the feeder, based on population concentrations. Any decision to angle or split the feeder at this point is based on the outcome of a test to determine whether this produces the least cost network. Subfeeder branches from the main feeder, every 1/200th of a degree boundary within ten kilofeet of the central office, and at most every 1/25th of a degree boundary beyond ten kilofeet from the central office. The direction of branching varies depending on whether or not the feeder has been directed at an angle from the cardinal direction. The BCPM 3.1 designs plant to connect customers based on the assumption of equal square-sized lots within square distribution areas whose total area is equal to the length of roads in the populated microgrids in the quadrant of the ultimate grid, times one thousand feet.

(3) Describe how the study determines whether cable should be placed as either aerial, underground (conduit), or buried. Please identify whether the study assumes that plant mix decisions will be affected by zoning restrictions and, if so, how.

The BCPM 3.1 determines the mix of aerial, underground or buried cable, by specific terrain and density factors for the ultimate grid involved. The model does not explicitly include zoning restrictions in plant mix decisions. This may tend to overstate the amount of aerial plant that could be actually placed.

Distribution

Distribution plant mix is determined based on one of three terrain types, each of which has an input table: normal, soft rock, or hard rock. Within each input table, the user may input a plant mix (percent aerial, buried, and underground) for each of nine density zones.

Feeder

Feeder plant mix is based on two sets of plant mix tables: one for copper and one for fiber. Both copper and fiber sets contain separate tables for normal, soft rock, and hard rock terrain types. Each terrain type table contains plant mixes for each of nine density zones.

Interoffice

The BCPM Transport module uses a fiber plant mix table similar to that of the feeder module. Each terrain type (for normal, soft rock, and hard rock) table contains plant mixes for each of nine density zones.

In additions to the structure dimensions captured in the tables, BCPM recognizes the impacts of water table depth and slope (slope creates a variation in structure cost proportional to the additional distance created). BCPM, rather than attempting to apply its own internal decision rules to determine structure percentages, uses data that the user has input to the above tables. This way, the user can be assured that the analysis fully reflects RUS, legal and regulatory constraints, slope and any other local factors beyond the scope of programmatic decision rules. BCPM, with its flexibility of input values allows the user to incorporate all relevant factors in the placement decision without resorting to an override process that is beyond user control.

The BCPM does recognize common zoning restrictions in its selection of DLC devices and Feeder Distribution Interfaces (FDI). The cabinet size of these devices is critical because of the limitations of utility easements. The equipment used in BCPM was selected in part for its ability to fit within common easements.

(4) Does the study incorporate wireless technology? If so, please describe how.

The BCPM 3.1 does not explicitly include wireless technology. However, it enables a user adjustable "cap" which U S WEST set at $15,000 for the runs in this proceeding, to be placed on the investment in loops, possibly reflecting the availability of technology such as wireless that would become economical if the cost to provide wireline service equaled that level.

The cap on investment also provides regulators/policy makers the opportunity to limit investment per line, for purposes of universal service funding. Invoking this cap reduces the average cost per loop.

(5) Does the study incorporate host-remote-switching configurations? If so, how? In your explanation, please discuss how host locations are identified and how costs are allocated among customers in wire centers that are part of host-remote relationships.

The FNPRM, ¶ 122, tentatively concluded that the model should enable the placement of host switches in certain wire centers and remote switches in certain wire centers. BCPM 3.1 meets these requirements. BCPM 3.1 has separate switch models for host, remote and stand-alone switches. The BCPM 3.1 places hosts and remotes based on the nature of the switch that is currently in that switching node, according to the LERG. The BCPM 3.1 Switching Module has a detailed method for allocating costs of the switches on the basis of functional categories of investment, so that customers in the host-remote relationship, pay for the cost of the functions they use. Switching investments are allocated among customers as follows: The processor investment per line is determined by a three-step process that allocates the host processor investment across all switches on the host/remote complex. The first step is to divide the total USF processor investment for all switches on the complex by the total number of lines on the complex. This produces a host processor investment per line. The second step is to divide the processor investment for each remote switch by its associated number of lines. This produces a remote processor investment for each remote. The final step is to compute the total processor investment per line for each switch. For stand alone switches, this is simply the processor investment from step 1. For hosts and remotes in the same rate center, the per line investment is the weighted average of the host investment for the host and the host plus remote investments for each remote. This produces a single processor investment per line for all switches in the rate center. For remotes located outside the host rate center, the processor investment is the sum of the host processor investment per line and the remote processor investment per line.

The trunking and SS7 host office investments must be allocated by complex, since remotes are assumed not to have these facilities and use the trunking and signaling resources of the host. For each complex, BCPM divides the host USF trunking investment by the local trunk usage for all switches on the complex. SS7 investments are handled similarly.

(c) Describe how the study incorporates assumptions that the incumbent LECs' wire centers are the center of the loop network and that the outside plant terminates at the incumbent LECs' current wire centers.

The starting point of the BCPM 3.1 design is the existing central office locations. The model uses the wire center V and H coordinate location information from Bellcore's Local Exchange Routing Guide (LERG) to locate the central office within the wire center. Feeder routes are designed to begin at this point, and move out to cover the wire center geography based on the methodology explained in Section B.1.b. (above)

(d) Describe how the loop design incorporated into the study does not